Nuclear Physics at LANL

Funding FY2000: Ops- $9728K, CE- $1510K FY2001: Ops- $8868K, CE- $533K
FY00 Staffing (Headcount): Perm PhD: 36 Unsupported Staff (LDRD): 25
Tech/Admin: 9/1 Unsupported Tech (LDRD): 6 Postdocs/G.S.: 19/11 Undergraduate: 12

We do not run a facility for Nuclear Physics at LANL, but the LANSCE neutron nuclear physics program provides unique capabilities and draws international collaborations to LANL for these experiments. As examples:

$n+p \rightarrow d+\gamma$: Total = 40 collaborators, PhD/GS/Other = 80/3/17 percent, DOE/NSF/Other US/Foreign = 40/20/13/27 percent.

UCN "A": Total = 48 collaborators, PhD/GS/Other = 65/15/20 percent, DOE/NSF/Other US/Foreign = 38/40/0/22 percent.

Questions

1 What are the main new research initiatives which are being proposed for your facility during the coming years? Are there specific facility upgrades which you are pursuing to maintain the competitiveness of your facility through the next decade?

The base program at Los Alamos includes (1) major construction activities at RHIC leading to a research program in pp, pA, and AA physics, (2) a new neutron physics program at LANSCE using cold and ultra cold neutrons centering on neutron beta decay asymmetries of the neutron and parity violation in n p capture, as well as developmental work on a new measurement of the electric dipole moment (EDM) of the neutron, (3) neutrino physics both at FNAL on the Mini-BooNE experiment and SNO, (4) theory program, and (5) nuclear data and nuclear level densities.

The main new initiatives at Los Alamos include:

Recent advances at LANL in pulsed cold and Ultra-Cold Neutrons (UCN) have resulted in achieving the most intense pulsed cold and UCN neutron sources in the world at LANSCE. The majority of the capital equipment coming to Los Alamos at the present time is being used to complete construction of the $n+p \rightarrow d+\gamma$ and UCN "A" experiments. The pulsed cold neutron effort makes use of Flight Path 12 at the Lujan Center and will be the only pulsed cold neutron beam in the world devoted to nuclear physics. The first experiment using the beam line will be the $n+p \rightarrow d+\gamma$ experiment, run by a large international collaboration. Possible future experiments on FP12 include neutron beta decay measurements, spin precession in liquid helium and liquid hydrogen, and the neutron EDM. Our R&D work on UCN has allowed us to proceed with construction of a low power (3 kW beam) first-generation UCN source at LANSCE. An international collaboration plans to use this source in an accurate measurement of the beta asymmetry in neutron beta decay. The physics that we can study will probe the structure of the hadronic weak interaction, provide the most stringent test of the unitarity of the CKM matrix, probe the structure of the semi-leptonic weak interaction, and the size and origin of time-reversal-violating forces in strangeness conserving processes. Further UCN source development will take place to advance a new National UCN User Facility.

Our involvement in both the science and technology of rare isotope beams goes back to our Workshop on the Science of Intense Radioactive Ion Beams, held in Los Alamos in 1990, to the most recent RIA Applications Workshop held in Los Alamos last October. We have developed an R&D plan in support of RIA that includes both simulation/modeling and testing of RIA ISOL targets. We will be actively pursuing both a construction and research role in RIA, drawing on the considerable resources (both people and facilities) that can be brought to bear on this new facility. Highly relevant to the science of RIA would be new initiatives in measurement of neutron capture cross sections on small samples of radioactive and stable nuclides at LANSCE and new advances in magneto-optical trapping of radioactive ^{82}Rb atoms.

We are also evaluating a scientific hosting and research role if a new underground laboratory is sited at the WIPP facility in Carlsbad. Our track record in many of the key science areas to be addressed at a new underground laboratory, as well as our ability to support a diverse array of scientific activities at the WIPP site for the community, make Los Alamos a natural center for these activities.

2 The LRP Charge to NSAC explicitly asks us to consider the FY2001 Budget as the baseline budget for the field. Is this, in fact, a budget level which will allow your facility to operate in a lean, but competitive and cost effective manner, in the years to come? If not, what are the essential additional resources which you would require and the benefits that would accrue from them?

Constant dollar (or declining) funding has severely compromised our ability preserve core capabilities at Los Alamos and has led to declining infrastructure, both people and facilities. We have aggressively captured institutional funds to help offset these loses, but it is unlikely that we can continue to make up the ever-increasing funding gap presented by flat budgets. It is well known that the real inflation to scientific programs is often in excess of 5% per year. We are continuing to lose 1-2 people from the program each year to flat budgets. This is clearly a problem for the field in general. Every effort must be made to infuse new funding to the base research program to bring it back up to reasonable levels. This may be at the level of 10% per year for several years.

At Los Alamos, this was further exasperated by a $500K reduction in MEP funding in FY01 coupled with loss to inflation. Some of this was absorbed by establishing a new joint funding base for Milagro, removing it from DOE funding and establishing a shared costing arrangement between NSF and LANL institutional funding. However, this still resulted in the loss of an additional FTE from the nuclear physics program over the normal 1-2 people due to inflation.

In addition to the restoration of the base program, we would look to increased funding for new initiatives in the neutron physics program, such as EDM and neutron capture cross section measurements, RIA activities, and a potential support and research role at a new WIPP underground laboratory site.

3 What is the balance of your research program between work at your local facility and outside user efforts at other facilities in the US or abroad? Has this balance changed since the last LRP, and do you expect it to evolve further in the coming years?

Research at other facilities (RHIC, FNAL, SNO): 63%
Research at LANL (LANSCE): 37%

Note that some of the work for offsite activities still takes place at Los Alamos. For instance, much of the major construction activities for RHIC and SNO used facilities and personnel at Los Alamos.

At the time of the last Long Range Plan LAMPF/LANSCE was transitioning to DOE-DP, with final nuclear physics experiments such as MEGA and LSND coming to conclusion. We expect the present level of effort on and off site to remain roughly constant in the coming years.

4 Are you satisfied with your ability to attract and support top quality graduate students?

We have held fairly constant in graduate student participation on our major projects since 1997. This has come primarily with our collaborating university partners on major experiments.

5 Are there other aspects of your facility and programs which are unique or particularly noteworthy?

LANSCE offers the best opportunity in the near term for pulsed cold and ultracold neutron beams for nuclear physics. A world record for trapped UCN density was set this year, surpassing the ILL. Our scientists have an exceptional background in precision, fundamental experiments with neutrons and other probes. Our participation in PHENIX construction drew upon our ability to develop and fabricate large, high-resolution chambers for the muon tracking systems, and a large clean room and diagnostic capability for the MVD, as well as specialized electronic design capabilities for the FEE. Our leadership in the PHENIX muon program draws on our considerable past accomplishments at FNAL   We have developed capabilities in low background counting for SNO that are a match with anything else in the world. We also have extensive experience from 20 years of neutrino experiments at LAMPF that have provided the basis for our current efforts in Mini-BooNE. Both the accelerator and non-accelerator neutrino efforts are involved in developing future experiments (LENS and BooNE). Our simulation/modeling/beam facilities provide unique capabilities for the RIA R&D effort. Our theory and nuclear data programs have impact in many areas of the national nuclear physics program, not only supporting our experimental program at Los Alamos, but at JLAB and RIA as well.